In 1984, Palm Beach County and the Port of Palm Beach entered into an agreement for maintenance of the island, provided it remained a passive recreation area. The Port owned the island until December 1991, when it sold 40 acres on the north end to the Florida Inland Navigation District (FIND) for $2.2 million. Palm Beach County owns 3.6 acres on the north end of Peanut Island and in 1994, the County entered into lease agreements with the Port and FIND for development of the island's perimeter for the public of Palm Beach County.

4. PLAN FORMULATION

Existing Conditions

From 1937 to present, a hill of dredged material to the north and west of the Coast Guard Station on Peanut Island has been continuously fed with sand and silt dredged from the Inlet, Port of Palm Beach and the IWW. Today the densely forested hill of dredged material on Peanut Island rises approximately 40 feet above sea level within the Lake Worth Lagoon (Figure 7).

Peanut Island is located directly inside Lake Worth Lagoon facing Lake Worth Inlet, and is strongly affected by the presence of the inlet with regard to tidal currents, attack from waves propagating through the inlet, and large water-surface elevation variations due to storm surges. The island has experienced erosion, primarily along the southeastern corner, which has experienced moderate to severe erosion due to surges and wave action. According to the Coastal Systems International (CSI), the resulting scarps on the southeastern corner have an average height of approximately 4.0 feet.

Significant changes in the horizontal position of the Peanut Island shoreline were noted by CSI from examination of aerial photos of the island taken between 1968 and 1993. The photos indicate that the southeast corner of the island has experienced a consistent shoreline retreat of approximately 100 feet between the years 1968 and 1993. The aerials show both shoreline retreat and advancement on the west side of the island. Specifically, between the years 1968 and 1977, the shoreline near the west project site advanced (accreted) approximately 100 feet, while the same reach of shoreline exhibited a retreat of approximately 50 feet between 1977 and 1993 (CSI Report). These changes indicate that the island is located in a highly dynamic area and is exposed to many coastal processes that will need to be addressed in the project design.

The island is currently dominated by exotic vegetation, primarily Australian pine and Brazilian pepper, which have created an impenetrable thicket, so concentrated that the majority of the island is inaccessible (Figure 8). An isolated mangrove forest (3.0 acres) exists on the west side of the island, which is impounded by a sand berm and only flushes at spring high tides.

FIGURE 7. PEANUT ISLAND TOPOGRAPHIC SURVEY

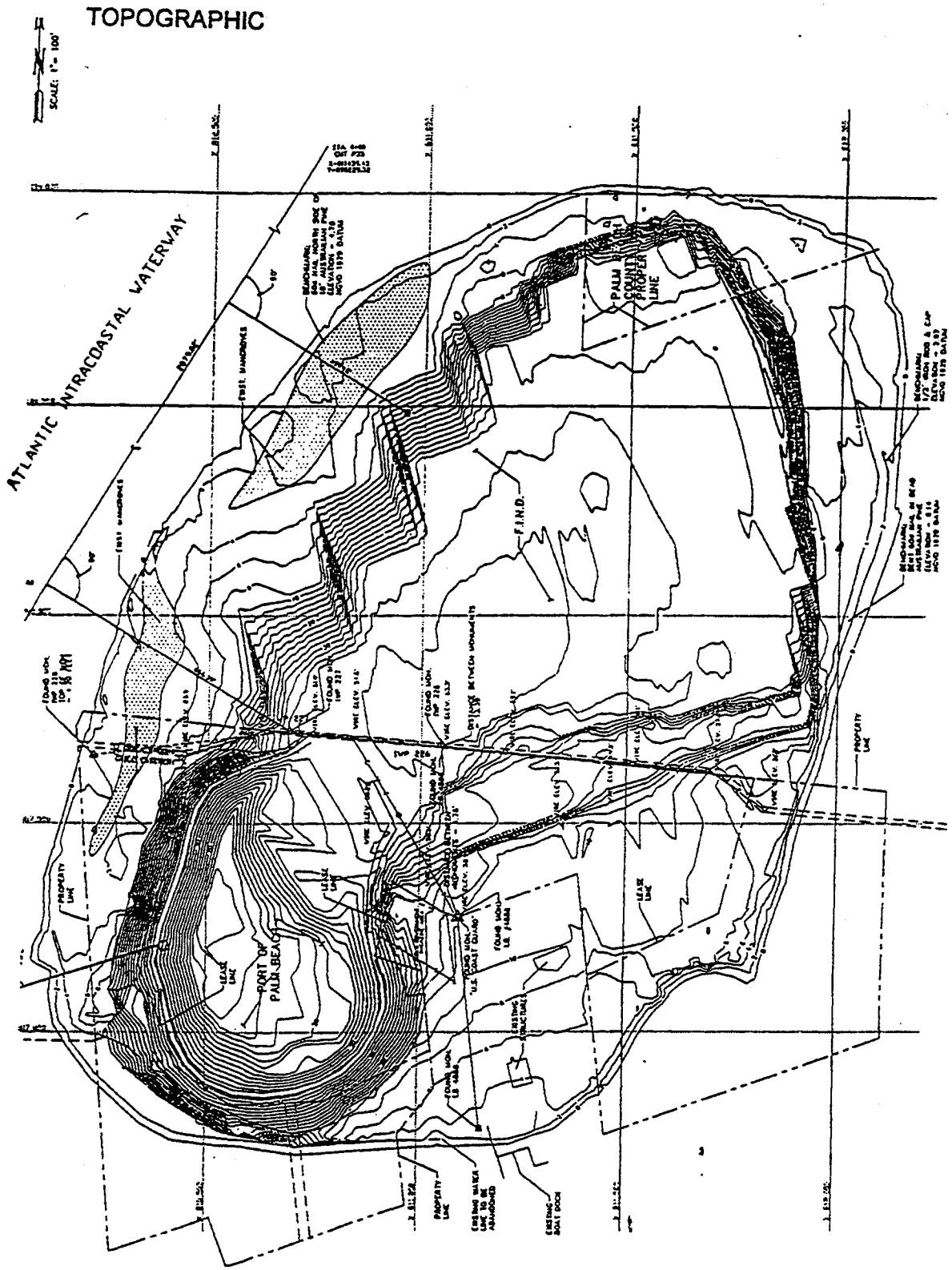
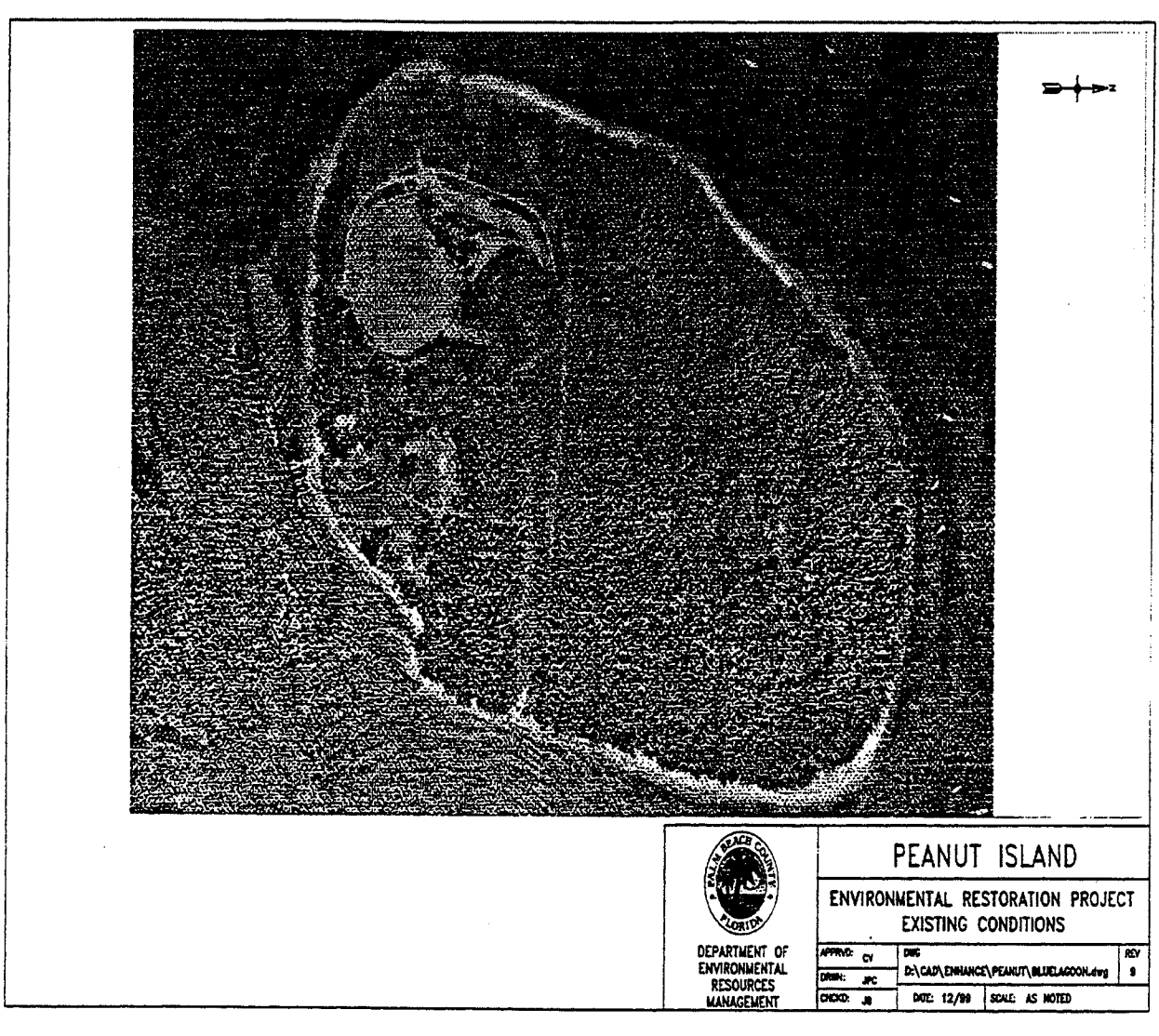


FIGURE 8. AREIAL PEANUT ISLAND EXISTING CONDITIONS



Palm Beach County owns 3.6 acres of Peanut Island and leases 23 acres from FIND and 36 acres from the Port of Palm Beach under long term lease agreements. These agencies are working cooperatively towards the implementation of a 4 million dollar master plan that will enhance and rehabilitate the island's environment into suitable habitat for fish and wildlife. The addition of public access amenities on Peanut Island was initiated in 1998 and consists of a fishing pier, boat dock, perimeter path, campsites, restrooms/showers and a caretaker facility. Associated recreational activities will provide a key water-oriented County Park for residents and visitors of Palm Beach County.

Future without Project Conditions

The island will continue to be dominated by exotic vegetation, primarily Australian pine and Brazilian pepper. An isolated mangrove forest (3.0 acres) exists on the west side of the island, which is impounded by a sand berm and only flushes at spring high tides. As a result, the exotic plants could dominate the already degraded mangroves and take over the area.

Problems and Opportunities

Historically, the area occupied by Peanut Island was a submerged shallow-water habitat. Created in 1918 by placement of dredged material from the excavation of the channel between Lake Worth and the Atlantic Ocean, Peanut Island encompassed an area of ten acres. When the Port of Palm Beach, then known as the Lake Worth Inlet District acquired the island in 1923, it had grown to 47.34 acres. Today, the island encompasses an area of 79 acres, resulting in the filling of 79 acres of shallow-water habitat adjacent to the mouth of the inlet.

Peanut Island is located directly inside Lake Worth Lagoon facing Lake Worth Inlet, and is strongly affected by the presence of the inlet with regard to tidal currents, attack from waves propagating through the inlet, and large water-surface elevation variations due to storm surges. The island has experienced erosion, primarily along the southeastern corner, which has experienced moderate to severe erosion due to surges and wave action. This area is a highly dynamic area and is exposed to many coastal processes that will need to be addressed in the project design.

A 1990 study, *Lake Worth Lagoon Natural Resources Inventory and Resource Enhancement Study*, performed by ERM rated Peanut Island as a high priority site for restoration (Dames and Moore, 1990). Twenty habitats along Lake Worth Lagoon Estuary were selected, identified, and evaluated in order to establish a prioritized list of areas in need of restoration. Evaluation for rating the sites was based on the following criteria: construction resources requirements, maintenance requirements, ecological benefits, land availability, public acceptance, probability for success, and proximity to significant natural resources.

Peanut Island was selected as a high priority site due to its location on public lands and the owners' willingness to cooperate in restoration efforts on the island. Public acceptance of a restoration project in this area has been extremely favorable, providing that public use of the island is not impeded, but enhanced. In a system that has lost much to development, the ecological benefits to be realized from restoring and creating additional wetland and upland habitat, is significant.

Palm Beach County has more than 100 miles of shoreline with estuarine habitat within the boundaries of the Intracoastal Waterway. Lake Worth Lagoon comprises more than 50% of this estuary and is recognized as one of the area's most important estuarine lagoon systems. Estuaries are among the most productive ecosystems on Earth because

of their salt and freshwater interaction and their shallowness compared to open seas. The restoration of Peanut Island will rejuvenate this portion of the Lake Worth Lagoon by increasing habitat and food supply for estuarine dependent fauna and flora.

The Florida Department of Environmental Protection (FDEP) has designated the Lake Worth Lagoon as an *"Ecosystem Management Area"* (Appendix A). This designation prioritizes the water body and ranks it as an estuary in need of protection and restoration as part of FDEP's Ecosystem Management Areas Plan, 1997. A steering committee has been established which is co-chaired by the Director of FDEP's Southeast District Office and a Palm Beach County Commissioner. Current FDEP Ecosystem Management efforts strive to coordinate the efforts of 30 municipal, state, county and regional governments that affect or oversee the lagoon. The Lake Worth Lagoon Ecosystem Management Mission Statement is as follows:

> *To restore, conserve and manage the Lake Worth Lagoon Ecosystem to a level of quality to obtain measurable and significant improvement to the Lagoon's water and sediment quality; and to provide habitat for native plants, fish and wildlife, and aesthetic, recreational and economic benefits for the residents and visitors of Palm Beach County; and to encourage, develop and promote a partnership of public and private interests to manage the Lagoon.*

Under Palm Beach County's Comprehensive Management Plan and FDEP's Ecosystem Management Plan, the County Department of Environmental Resources Management has identified numerous objectives to restore and protect the lagoon. These objectives include recommendations for habitat restoration, which have been realized with the completion of the Munyon Island Environmental Restoration Project and the initiation of the Peanut Island Environmental Restoration Project. The Peanut Island Environmental Restoration Project elements are in direct agreement with the goals of the proposed Ecosystem Management Area Plan for the Lake Worth Lagoon. The restoration project has been selected to receive local funding through the Lake Worth Lagoon Partnership Program in the amount off $250,000.

Constraints

Peanut Island is located approximately 150 ft. east of the Intracoastal Waterway (IWW), 1500 ft. west of the Lake Worth Inlet and 600 ft. east-northeast of the Port of Palm Beach. The southeasterly section of the boundaries of the project can not encroach on the Palm Beach Federal Channel Right-Of-Ways limits. Any construction including rock placement is not allowed within 100 feet from the IWW and Palm Beach Federal Channel.

There are two active dredge material disposal sites currently on the island: FIND dredge material disposal site and Port of Palm Beach disposal site. The project modifications can not conflict with the intentions of the FIND dredge material disposal site and the Port of Palm Beach dredge material disposal site.

Objectives

Development of objectives for the restoration of Peanut Island began in 1990 with numerous meetings between Palm Beach County, Port of Palm Beach, Florida Inland Navigation District, Palm Beach Maritime Museum and the Public. Objectives were also based on the joint effort of the Corps' and Palm Beach County's recent environmental restoration of 20 acres of wetland and 25 acres of upland habitat on nearby Munyon Island. The objectives consider the combined interest of the land owners and involved agencies. The developed objectives are listed below:

List of Objectives

1. CREATION OF HABITAT FOR HALOPHIA JOHNSONII
2. ENHANCE WATER QUALITY
3. COLONIZATION OF ALGAL COMMUNITIES AND OCEANIC LARVAE
4. CREATION OF A NURSERY HABITAT FOR INVERTEBRATES AND JUVENILE FISH
5. CREATION OF A HABITAT FOR REEF FISH
6. RECRUITMENT OF BENTHIC ORGANISMS
7. CREATION OF HABITAT FOR BIRDS, INCLUDING MIGRATORY BIRDS, AND OTHER WILDLIFE
8. CREATION OF TRANSITION ZONE BETWEEN WETLAND AND UPLAND HABITATS
9. PREVENTION OF RECOLINIZATION OF EXOTIC VEGETATION
10. PROTECTION OF SHORELINE FROM EROSION/LOSS OF HABITAT

Measures

A list of measures was determined with each measure meeting at least one of the objectives. The reason for selecting each measure is explained below.

Measure 1. Creation of Shallow-Water Reef Habitat

Palm Beach County Department of Environmental Resources Management has documented the loss of approximately 17.9 acres of shallow-water reef habitat in the vicinity of Peanut Island. These losses are attributable to Inlet and IWW creation and maintenance. In assessing fines for reef damages, a value of up to $1000/square meters has been attributed to reef communities by the National Marine Sanctuary Program administered by NOAA (National Ocean and Atmospheric Administration). A loss of that magnitude today would be assessed up to $74,157,000. Therefore the creation of a 1.3 acre shallow-water reef is partial retribution for nearby reef loss in past years. The proposed rocks along the inlets and shallow-water reef habitat on Peanut Island will provide an ideal place and substrate for larvae to settle and colonize. A long term goal for the proposed reef system is the development of corals. Currents through the reef system will cause some sand movement and scouring effects along the sand-rock interface. The development of a reef system to -10' NGVD will assure that hard corals will have ample area to establish above the zone affected by scouring or sedimentation. Corals and sponges are limited in occurrence to areas within close proximity to inlets. Therefore, the

proximity of this project area to the Lake Worth Inlet cannot be underrated. Peanut Island's surrounding waters have a high species diversity due to the island's proximity to Lake Worth Inlet and oceanic waters. The Gulf Stream travels closer to the Lake Worth Inlet than anywhere else along the east coast of the United States, making this a highly unique and diverse area. The location presents the opportunity for an extraordinary fisheries enhancement project through the creation of the proposed shallow-water reef system.

Measure 2. Creation of Shallow-Water Lagoon by Removing Dredge Material and Planting Mangroves (Southeast)

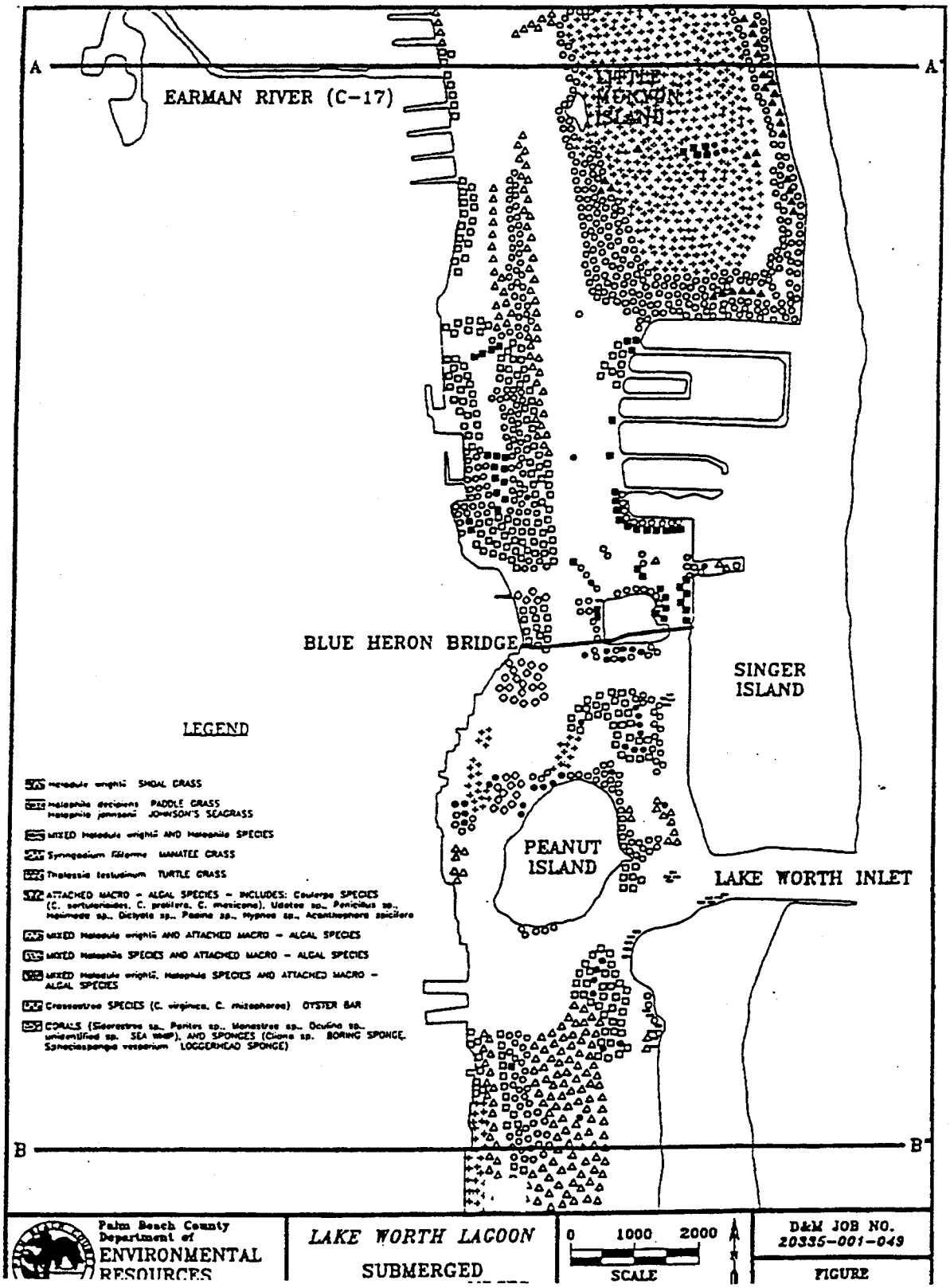
The second most important primary producer in estuaries is seagrass. Heald and Odum (1969) noted that, in addition to mangroves, turtlegrass (seagrass) contributes significantly to the detrital food chain in estuaries. McCrary et. al (1985b) made the following statement: "Florida's marine resources represent a multi-billion-dollar renewable asset, and exceed, in combined value, the phosphate, citrus, and cattle industries in economic importance. However, we are at risk of losing these resources largely through the degradation and modification of aquatic habitats." Seagrass and macro algal communities provide very important habitat for many marine species. Their continued survival and proliferation in Lake Worth Lagoon is dependent upon protection from direct impact and maintenance of good water quality. The creation of shallow-water substrate will provide a stratum for recruitment and colonization of seagrasses and benthic organisms.

With review of historic and bathymetric maps, it has been determined that shallow-water habitat, including seagrasses and other bottom communities are the primary resources that were eliminated due to the placement of dredged materials in the 79 acre footprint that is now Peanut Island. In addition to the area filled, roughly another 75 acres of seagrass habitat has been lost due to dredging activities associated with the creation and maintenance of the inlet and the IWW.

Within the wetland habitat created on nearby Munyon Island, Palm Beach County staff have recorded the presence of a number of seagrass and algal species including *Halodule wrightii, Thalassia testudinum, Halophila johnsonii, Halophila decipiens, Caulerpa sertularioides*, and *Gracilaria tikvahiae*. The seagrass species *Halophila johnsonii* is currently a threatened species. National Marine Fisheries Service Final Rule listing the grass as a threatened species was published 14 September 1998, 63 Federal Register 49035 (to be codified at 50 C.F.R. Part 227.)

Upon examination of the documented seagrass habitat one mile to the north and south of Peanut Island, the only areas devoid of seagrasses tend to be the deep water areas, primarily those created as a result of the IWW and Inlet (Figure 9). The loss of shallow-water habitat (seagrasses and benthic community) in the vicinity of Peanut Island (one mile north and south) directly attributable to dredge and fill activities is estimated at 154 acres which represents a recurring loss of $3,157,000/annually when consumptive and

FIGURE 9. SUBMERGED WETLANDS



non-consumptive values are applied.

As discussed in the Environmental Assessment associated with this report, recent studies indicate seagrasses are a scarce resource in Palm Beach County. Studies analyzing such factors as nutrient cycling, raw materials, and support for recreational and commercial fisheries, provide a conservative estimate of the economic value of seagrasses at $20,500/acre/year(McCrary, 1985). Using this value, the proposed restoration project has the potential to provide a renewable resource valued at up to $92,250/year in shallow-water habitat alone based on 3.0 acres shallow-water lagoon and 1.5 acres tidal pond and channels created or up to $420,250/year when including the 16 acres of proposed submerged wetland resources to be restored.

Most of the Lake Worth Lagoon shoreline has been altered by dredging, filling, and bulkhead construction. Mangrove communities provide habitat for marine organisms, protect shorelines from erosion, and enhance water quality by acting as natural filters. Detrital material produced by mangroves is the basis of the food chain for South Florida's marine and estuarine ecosystems. An ultimate goal of the proposed restoration project is to optimize the quality of productive wetland habitat to promote fisheries and wildlife. Over 70% of local commercial and recreational fisheries depend upon the mangrove wetland habitat at some time within their lifecycle. Restoration of Peanut Island will provide an opportunity to restore existing wetland habitat.

Peanut Island contains two isolated mangrove areas, primarily red and black mangroves, totaling approximately 3.0 acres (Figure 8). These mangrove areas are effectively sealed off from tidal influence, resulting in a biologically non-productive system, which has been invaded and impacted by exotic vegetation. The project proposes excavation of an inlet, tidal pond, flushing channels and seagrass recruitment habitat to move tidal waters into and through the existing mangrove habitat, optimizing the productivity of this wetland.

A major source of primary productivity (the foundation of the food chain) in an estuary is the detrital source provided by the mangrove/spartina wetland habitat. The ecological value of mangrove communities has been well documented in the scientific literature. The value of mangroves and wetland habitat is determined to be $9,000/acre/year (net dollars) in fisheries alone (J. Beaver, DNR) and up to $90,000/acre/year when non-consumptive values are applied, such as recreation, nutrient removal, and wildlife habitat (W.E. Odum). The State of Florida Department of Environmental Protection (FDEP) has determined that estuarine wetlands have an average annual value of $60,000/acre/year (Waldner, et al., 1989). Using FDEP's most recent determination of estuarine value, the restored 3.0 acre mangrove wetland on Peanut Island would have a value of $180,000/yr.

Measure 3. Creating Tidal Pond/Flushing Channel by Removing Dredge Material (West)

Restoration of existing mangroves on the west side of Peanut Island will be facilitated through the creation of a tidal pond and a series of flushing channels. The tidal pond will be excavated and will be stabilized by exterior groin features, which will limit sediment deposition in the tidal pond entrance and provide protection from storm waves and current erosion. The primary purpose of the tidal pond is to provide flushing to the existing mangrove wetland community. In addition, a shallow-water lagoon shelf and transitional slope encircling the tidal pond basin will promote colonization of the habitat by seagrasses and other marine vegetation and organisms. The reasons for selecting Measure 3. are the same reasons for selecting Measure 2.

Measure 4. Filling an IWW Anoxic Hole with Dredge Material

Dredge material will be generated and removed from the island as a result of restoration. The dredged material located on Peanut Island originated in the vicinity of Lake Worth Lagoon and Inlet. While it is recognized there is a need for a sand source for local beaches, this material is known to contain rock and coral and would not be considered 'beach quality' without screening. Analysis of sediment core samples indicate that the material is suitable for placement within the Lake Worth Lagoon. This material presents an opportunity to restore a dredged area located within the Lake Worth Lagoon. An anoxic dredged site known as the City of Lake Worth Wetland Restoration area, has been identified to accommodate dredge material. The proposed design elevation has been selected as the desired depth, which emulates surrounding submerged bottom currently supporting mangrove, seagrasses and oyster habitat. The reasons for selecting Measure 4. are the same reasons for selecting Measure 2. and Measure 3.

Measure 5. Removal of Exotic Vegetation

Removal of this extensive source of exotic vegetation and subsequent seed source will be an immediate benefit to the surrounding area. With the funding and resources being put toward the development of Peanut Island, a long range goal is the removal of all exotic vegetation and seed source from the Island. The efficient use of the exotic vegetation by chipping it on site and utilizing the material as a mulch substrate for upland plants will be a major project benefit both ecologically and economically.

Measure 6. Beach Dune

Beach Dunes are very dynamic communities, which take the brunt of storm surge and high winds, which protect inland biological communities. The vegetation is able to tolerate exposure to wind, intense sun, salt spray, sand abrasion and establish within steeply sloped areas. These characteristics are the primary reasons for their unique ability to stabilize shorelines. Beach dune, along its ecotone with the unvegetated beach, provides habitat for many animals and invertebrates, including nesting habitat for numerous shorebirds.

The establishment of the beach dune habitat will stabilize the project slopes and prevent reoccurrence of exotic vegetation along the fringe of the newly restored wetland area. The zone that lies between uplands and wetlands is a zone of transition, sometimes called an ecotone. It is known that the highest species diversity occurs in these areas of habitat overlap (Brown, et al., 1987). The species utilized within this special ecotone will be an overlap of wetland, coastal strand and coastal dune vegetation, which will colonize quickly to stabilize slopes and protect the integrity of bordering habitats.

Measure 7. Coastal Strand

Coastal Strand is characterized as stabilized coastal dunes that are vegetated with a dense thicket of salt-tolerant shrubs. Coastal Strand is actually an ecotonal community that generally lies between Beach Dune and Maritime hammock. The coastal strand community is probably the most rapidly disappearing community in Florida. It is most extensive along the Atlantic Coast where, being elevated and next to the coast, it is prime property for development. Coastal Strand originally occurred as a nearly continuous band along the Atlantic shorelines. Now it occurs largely as broken and isolated small stretches. In south Florida, in addition to developmental pressures, it has also has been disturbed by displacement by exotic plant species, primarily Brazilian pepper and Australian pine. Along with other coastal communities, Coastal Strand protects inland communities from the effects of storms.

Measure 8. Maritime Hammock

Creating a maritime hammock area on Peanut Island, immediately adjacent to coastal mangrove wetlands, will enhance plant communities and provide wildlife habitat for many species of avian fauna and wildlife which will make use of this area to fulfill their needs for water, food, and cover. The dense canopy of hardwood hammock vegetation will attract a different component of the wildlife community, including animals like gray squirrels, raccoons (already present on the island) and especially migratory songbirds. There is tremendous interest in the conservation and management of neotropical migratory birds within the conservation community.

In southern Florida, migrating and overwintering songbirds and raptors depend heavily on the cover and abundant food available in coastal hammocks. Migrating birds use the coastlines as travel corridors, and patches of densely canopied forests are like magnets to these weary travelers. Restoring upland hammock immediately adjacent to coastal mangrove wetlands will enhance both plant communities as wildlife habitat, and many species of wildlife will make use of both areas to fulfill their needs for water, food, and cover. Maritime hammocks in southeastern Florida are virtually gone according to M.S. Robson, Regional Non-Game Wildlife Biologist for the Florida Fish and Wildlife Conservation Commission, see Appendix B.

Table 1 displays what measures meet what objectives. Alternatives were developed based on the measures meeting the objectives.

TABLE 1: OBJECTIVES/MEASURES MATRIX

#	MEASURES	OBJ 1.	OBJ 2.	OBJ .3.	OBJ 4.	OBJ 5.	OBJ 6.	OBJ 7.	OBJ 8.	OBJ 9.	OBJ 10.
1	CREATING SHALLOW-WATER REEF BY REMOVING MATERIAL AND PLACING ROCKS		X	X	X	X	X				X
2	CREATING SHALLOW-WATER LAGOON BY REMOVING DREDGE MATERIAL AND PLANTING MANGROVES	X	X				X	X		X	X
3	CREATING TIDAL POND/FLUSHING CHANNELS (WEST) BY REMOVING DREDGE MATERIAL	X	X				X	X		X	X
4	FILLING AN IWW ANOXIC HOLE WITH DREDGE MATERIAL	X	X				X	X		X	X
5	EXOTIC VEGETATION REMOVAL									X	
6	RE-CONTOURING THE EXISTING GRADE BY REMOVING DREDGE MATERIAL AND PLANTING NATIVE BEACH DUNE VEGETATION							X	X	X	
7	RE-CONTOURING THE EXISTING GRADE BY REMOVING DREDGE MATERIAL AND PLANTING NATIVE COASTAL STRAND VEGETATION							X	X	X	
8	RE-CONTOURING THE EXISTING GRADE AND PLANTING NATIVE MARITIME HAMMOCK VEGETATION							X	X	X	
9	EROSION PROTECTION ON THE SOUTHEAST SIDE OF THE ISLAND BY PLACING ARMOR/CORE ROCK AND CONSTRUCTION OF CRIB ASSEMBLY			X	X	X	X				X

LIST OF OBJECTIVES

1. CREATION OF HABITAT FOR HALOPHIA JOHNSONII
2. ENHANCE WATER QUALITY
3. COLONIZATION OF ALGAL COMMUNITIES AND OCEANIC LARVAE
4. CREATION OF A NURSERY HABITAT FOR INVERTEBRATES AND JUVENILE FISHES
5. CREATION OF A HABITAT FOR REEF FISH
6. RECRUITMENT OF BENTHIC ORGANISMS
7. CREATION OF HABITAT FOR BIRDS INCLUDING MIGRATORY BIRDS AND OTHER WILDLIFE
8. CREATION OF TRANSITION ZONE BETWEEN WETLAND AND UPLAND HABITATS
9. PREVENTION OF RECOLINIZATION OF EXOTIC VEGETATION
10. PROTECTION OF SHORELINE FROM EROSION

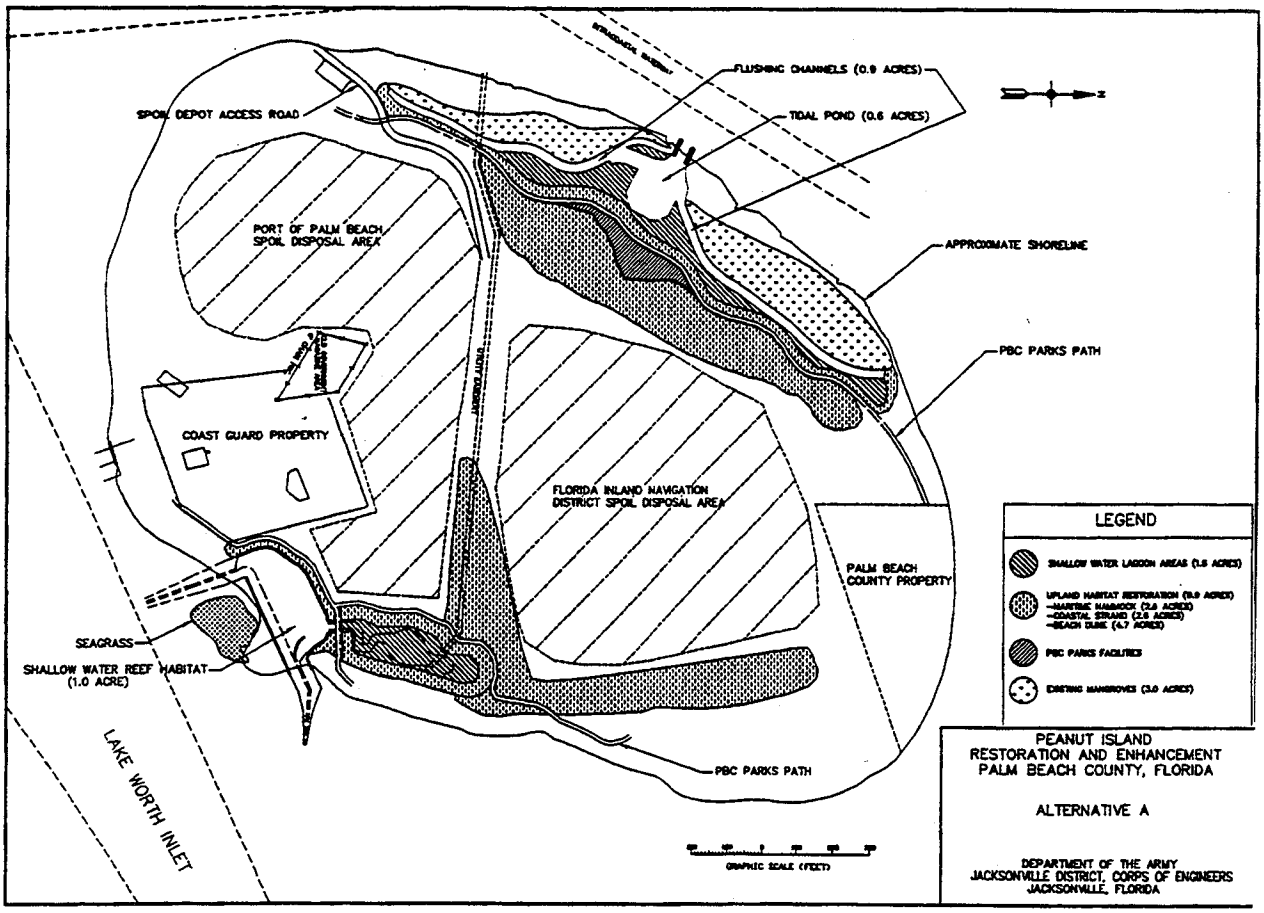
Description of Alternatives

Alternative A:

1. Create 1.0 acre shallow-water reef habitat
2. Create 2.0 acres of shallow-water lagoons (east and west)
3. Restore 3.0 acres of mangrove wetland
4. Create 1.5 acres of tidally connected inlet, pond and flushing channels
5. Restore 2.6 acres upland habitat: maritime hammock
6. Restore 2.6 acres upland habitat: coastal strand
7. Create 4.7 acres beach dune habitat (east and west)
8. Remove 17.4 acres of exotic vegetation
9. Restore 4.8 acres of submerged wetland resources

Alternative A (Figure 10) consists of creating a shallow-water reef habitat by clearing exotic vegetation and excavating into the existing upland on the southeast side of Peanut Island. A shallow-water lagoon (east) will be constructed adjacent to, and flow into the shallow-water reef habitat. The shallow-water reef habitat will be lined with limestone rock to stabilize the sides and inlet, as well as provide a reef substrate for the colonization of corals, sponges and other invertebrates.

FIGURE 10. ALTERNATIVE A



Additional wetland habitat will be provided on the island's western side by restoring existing impounded mangroves by re-introducing tidal waters through the creation of an inlet, tidal pond, flushing channels and shallow-water lagoon (west). The inlet cut between the mangroves will be lined with limestone rock to stabilize the inlet and connections between the tidal pond, flushing channels and shallow-water lagoon. The creation of the wetland project areas (shallow-water reef, shallow-water lagoon and mangrove restoration including tidal pond and flushing channels) will generate approximately 86,305 cubic yards of dredged material. The material will be removed from the island and deposited in dredged area within Lake Worth Lagoon to restore approximately 4.8 acres of submerged wetland resources.

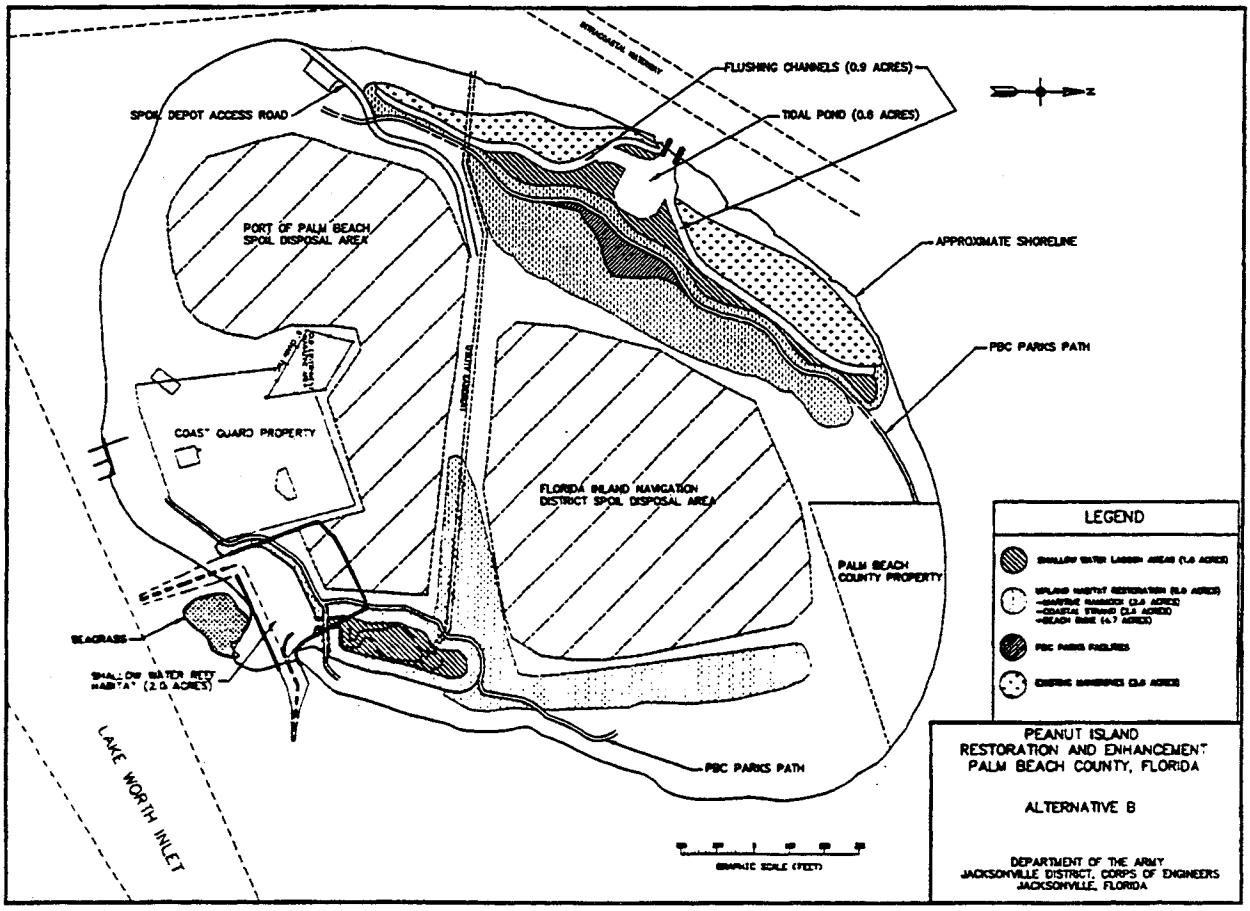
Upland habitat will be created by clearing exotic vegetation (primarily Australian pine) which will be chipped on site. The resulting chips will be spread on the ground and used to mulch upland areas, primarily the maritime hammock. The mulch will preclude the recurrence of exotic vegetation, maintain soil moisture and supplement nutrients for the native plants and trees to be installed.

Alternative B:

1. Create 2.0 acres shallow-water reef habitat
2. Create 1.6 acres shallow-water lagoon (east and west)
3. Restore 3.0 acres mangrove wetland
4. Create 1.5 acres of tidally connected inlet, pond and flushing channels
5. Restore 2.6 acres upland habitat: maritime hammock
6. Restore 2.6 acres upland habitat: coastal strand
7. Create 4.7 acres beach dune habitat (east and west)
8. Remove 18.4 acres of exotic vegetation
9. Restore 6.2 acres of submerged wetland resources

In an effort to increase wetland habitat and optimize the benefit of the island's proximity to the inlet, Alternative B was considered with all components of Alternative A, but with an increase to Component 1, the shallow-water reef habitat (Figure 11).

FIGURE 11. ALTERNATIVE B.

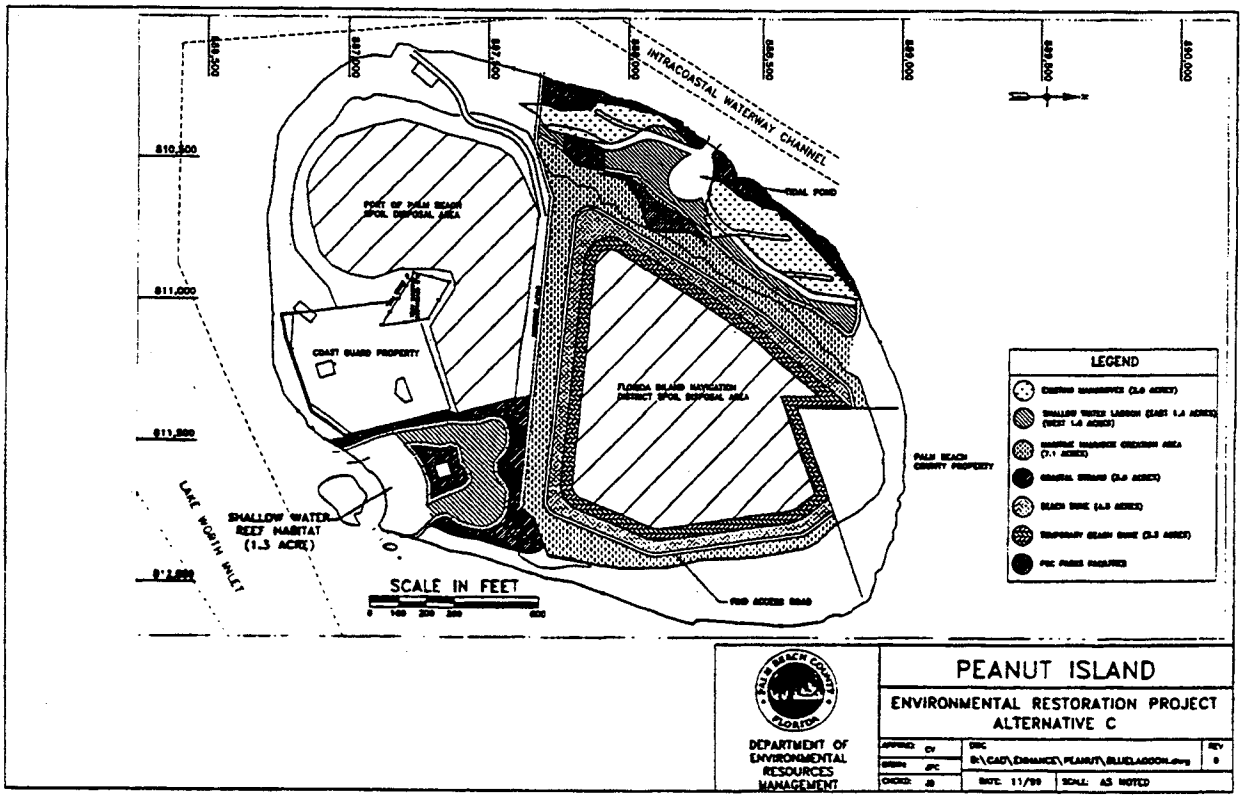


Alternative C:

1. Create 1.3 acres shallow-water reef habitat
2. Create 3.0 acres shallow-water lagoon (east and west)
3. Restore 3.0 acres mangrove wetland
4. Create 1.5 acres of tidally connected inlet, pond and flushing channels
5. Restore 7.1 acres maritime hammock
6. Create 3.9 acres coastal strand
7. Create 4.6 acres beach dune + 3.3 acres temporary beach dune
8. Remove 28.4 acres of exotic vegetation
9. Restore 16.0 acres submerged wetland resources

Figure 12 illustrates the features of Alternative C. In an lease amendment approved on December 16, 1998, the Port of Palm Beach leased additional Port property (2.8 acres) to Palm Beach County in the southeast corner of the island for the development of additional environmental features. Through meetings with the involved agencies, it was determined that the shallow-water lagoon habitat (east) was environmentally the best feature to augment within the additional property.

FIGURE 12. ALTERNATIVE C



Palm Beach County has collaborated with the Florida Inland Navigation District (FIND) to optimize upland restoration on FIND's property between Peanut Island Park and the FIND spoil disposal area. The resulting design would require reconstruction of a portion of FIND's spoil dike to provide a vegetative buffer between FIND's spoil disposal area and Peanut Island's restoration and park features. Reconfiguration of FIND's spoil dike will provide additional maritime hammock habitat and beach dune habitat, which will require the removal of approximately 200,760 cubic yards of dredged spoil material. This material, in addition to approximately 86,305 cubic yards generated from creating the wetland features, for a total of 287,075 cubic yards will be removed from the island and utilized to fill dredged areas within the Lake Worth Lagoon and subsequently restore 16.0 acres of submerged wetland resources.

Alternative D:

With the no action alternative, a project would not be implemented. Future conditions with no action are described in the Future Without Project Conditions section of this report. This alternative would not fulfill the objectives of restoring valuable wetland habitat or upland habitat on Peanut Island.

An Evaluation Matrix, Table 2, was prepared to examine the objectives with respect to the four Alternatives. The goal is to provide the most habitat for fisheries and wildlife, while preserving the zones designated for recreation and dredge material deposition.

TABLE 2. EVALUATION MATRIX

*Values in Acres

OBJECTIVES	Historic	Current	ALTERNATIVES A	B	C	D
Mangrove Habitat	0	3.0 Impacted	3.0	3.0	3.0	3.0
Seagrass Habitat	154	1.0	9.3	10.3	21.5	1.0
Habitat for Algal Communities and Oceanic Larvae	17.9	0	3.0	3.6	4.3	0.0
Nursery Habitat for Invertebrates and Juvenile Fishes	171.9	1.0	13.3	15.3	25.8	1.0
Habitat for Reef Fish	17.9	0	1.0	2.0	1.3	0.0
Benthic Organisms Habitat	171.9	1.0	13.3	15.3	25.8	1.0
Habitat for Birds and Wildlife	0	3.0	14.9	14.5	21.6	3.0
Beach Dune Habitat	0	0	4.7	4.7	4.6	0.0
Coastal Strand Habitat	0	0	2.6	2.6	3.9	0.0
Maritime Hammock Habitat	0	0	2.6	2.6	7.1	0.0

Selected Plan.

The three alternatives selected for study were evaluated on the basis of environmental benefits and project objectives. Under these analyses, Alternatives A and B were eliminated on the grounds that they produced less environmental benefits. Alternative C was determined to be the plan producing the greatest environmental benefits for the cost, as required under Federal guidelines for water resources development.

Alternative C appears to be in the best overall public interest and is the most beneficial environmental plan for implementation. There will be substantial benefits to fish and wildlife resources by restoring and creating wetland habitat which will provide habitat and food source for fish, invertebrates, wading birds and wildlife. Restoring wetland and upland habitat on Peanut Island will also directly benefit many threatened and endangered species by providing essential habitat that has been severely depleted due to development. Alternative C provides an opportunity to restore additional wetland habitat within Lake Worth Lagoon by utilizing the dredged material generated to create wetland and upland habitat on Peanut Island. It will also provide an environmental education area or "living classroom" for local schools and environmental groups.

Summary of Impacts.

Navigation Peanut Island is located approximately 150 feet. east of the Intracoastal Waterway (IWW), 1500 feet. west of the Lake Worth Inlet and 600 feet. east-northeast of the Port of Palm Beach. The IWW will be used to transport equipment to the Island. Southeasterly section of the boundaries of the project may encroach on the Palm Beach Federal Channel Right-Of-Ways limits. Also, it is projected in the future that the Palm Beach Federal Channel will be widened from 300 feet to 400 feet. The local sponsor was informed that any construction including rock placement is not allowed within 100 feet from the Palm Beach Federal Channel. This will be addressed in more detail in the Plans and Specs phase.

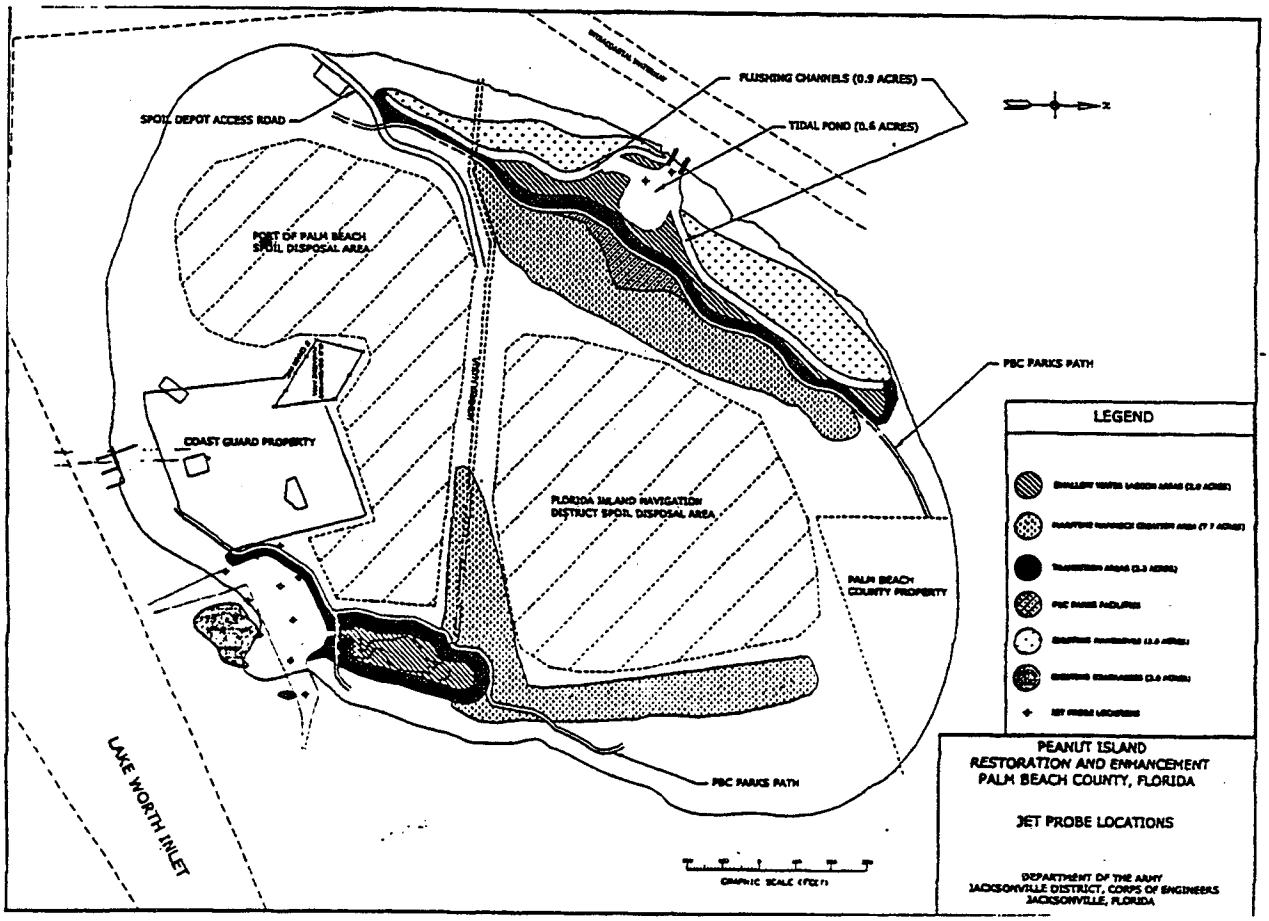
Geotechnical A subsurface investigation within the project area of the Peanut Island Environmental Restoration area was conducted by Palm Beach County Environmental Resources Management in January 1998. The investigation consisted of sediment sampling using an augering device to collect composite samples, which were analyzed for grain size distribution using wet and dry sieve methods, organic content (loss on ignition), and carbonate content (acid leaching). These samples represent an area of native Lake Worth bottom sediments.

Results of the sediment analyses are listed in Table 3. Sample numbers correspond to stations on the map (Figure 13). Appendix D contains grain size distribution curves and data sheets for the six samples. See the Geotechnical section of the Environmental Assessment for sediment analyses details.

Table 3.
Sediment Analysis Results

Mean Grain Size (mm)	Standard Dev(phi)		%Silt & Clay	%Organics	%Carbonates
S1	0.26	0.54	2.22	4.16	45.09
S2	0.32	0.52	1.19	5.08	45.01
S3	0.52	0.42	0.23	4.17	57.71
S4	0.20	0.33	1.02	1.12	14.78
S5	0.30	0.31	1.14	1.78	16.05
S6	0.14	0.70	2.88	2.88	7.75
Average	0.29	0.47	1.45	3.20	31.06

FIGURE 13. JET PROBE LOCATIONS



Water Quality

The proposed project will be in compliance with all Federal and non-Federal water quality requirements. Turbidity generated from this project shall be regulated as directed in the project permit. Water quality will be improved by the implementation of the proposed environmental restoration, and in particular, the following three components:

Mangroves. Water quality will be improved within the area by tidally connecting the existing impounded mangrove wetland, allowing it to function in its capacity of sediment stabilization and nutrient uptake.

Shallow-Water Lagoon/Seagrasses. The creation of the shallow-water lagoon habitat will result in the potential for seagrass recruitment that will further improve water quality by nutrient uptake, increasing dissolved oxygen and reducing sedimentation.

Shallow-Water Reef Habitat. The proposed reef will improve water quality and clarity in the Lake Worth Lagoon by providing an attachment point for benthic filter feeders and beneficial algae that will remove nutrients from the water column.

The reef project will also assist in the reduction of turbidity in lagoon waters by dissipating direct wave energy from the adjacent Lake Worth Inlet.

Fish and Wildlife

The proposed project, which is targeted to provide additional habitat resources, will have a positive impact on fish and wildlife. Creation of shallow-water reef and shallow-water lagoon in the vicinity of the Inlet will utilize clear oceanic waters which will optimize the colonization and recruitment of associated reef community. A stable or climax benthic community may take years to develop, but fish colonize new artificial structures within hours of immersion and well before the succession of algae and sessile invertebrates. These epifauna and epibiota supply a renewable primary food source for grazing fishes (Fitzhardinge and Bailey-Brock, 1989). The use of artificial structures to create habitat for fishes and invertebrates has been greatly supported as a fishery restoration tool.

Utilization of the dredged material deposits (generated during construction of this project) to fill dredged area within Lake Worth Lagoon will provide approximately 16.0 acres of additional shallow-water lagoon habitat conducive to the colonization of seagrasses.

The proposed mangrove wetland will provide habitat as well as a food source for fish, invertebrates, wading birds, and wildlife. The tidal pond, flushing channels and shallow-water lagoon, all with potential for seagrass recruitment, will provide additional fisheries habitat for juvenile fish species and invertebrates. Creation of maritime hammock, coastal strand and beach dune will provide adjacent upland habitat for bird and wildlife species, while providing an important unique zone between wetland and upland habitats.

The U.S. Fish and Wildlife Service, in its Environmental Scoping Letter on the Peanut Island Environmental Restoration Project supports the proposed resources to be created for the benefit of fish and wildlife (Appendix A). The Florida Department of Environmental Protection (FDEP) supports the proposed plan for creation of reef habitat on Peanut Island as noted in the FDEP fish survey conducted in the nearshore waters off Peanut Island (Appendix A). The Environmental Assessment included in this report thoroughly covers the benefits to fish and wildlife to be realized with the implementation of this environmental restoration.

Threatened and Endangered Species

In accordance with Section 7 of the Endangered Species Act, a biological assessment of potential impacts of the proposed work on threatened or endangered species was prepared and forwarded to the U.S. Fish and Wildlife Service. Federally protected species utilizing the wetland restoration project area that have been observed by State Biologists and County Environmental staff on nearby Munyon Island include: Wood Stork, Peregrine Falcon, Manatee, Least Tern, Common Snook, Little Blue Heron, Great Blue Heron, Reddish Egret, Snowy Egret, Gopher Tortoise, Brown Pelican, White

Ibis, and Osprey. Federally protected species utilizing nearby Munyon Island and its surrounding wetland habitat are listed in Table 11 of the Environmental Assessment, along with their Federal designation.

With completion of the Munyon Island Environmental Restoration Project, tidal channels and ponds have colonized with seagrass species. With implementation of this project, it is expected that the shallow-water lagoons, side slopes of the tidal pond and flushing channels have a high probability for recruitment of seagrasses similar to Munyon Island. In particular, these submerged wetland habitats have the potential to recruit *Halophila johnsonii. Halophia johnsonii* is currently a Federally threatened species. National Marine Fisheries Service Final Rule listing the grass as a threatened species was published 14 September 1998, 63 Federal Register 49035 (to be codified at 50 C.F.R. Part 227.)

Because of Peanut Island's shallow waters and surrounding seagrass beds, along with its proximity to the Inlet and Florida Power and Light (thermal waters), the West Indian Manatee (*Trichechus manatus*) utilizes the island's nearshore waters. The manatee may be found to utilize habitat created within the scope of this environmental restoration. If the Manatee is found to frequent these areas, additional boater caution signs may be necessary. During project construction, the "Standard Manatee Conditions", will be followed as stated in the project permit issued by the South Florida Water Management District.

The Environmental Assessment included in this report thoroughly covers the benefits to threatened and endangered species to be realized with the implementation of this environmental restoration.

Cultural Resources

Peanut Island was created around 1918 by the disposal of material dredged from the Lake Worth Inlet and has been enlarged through the disposal of material dredged from the Inlet, Palm Beach Harbor, and the IWW. Evidence of development during the historic period includes the former U.S. Coast Guard Station and the Kennedy bunker (old government magazine). While those resources are located on Peanut Island, they are located on an out parcel that will not be directly affected by construction of the environmental restoration project. Visitor use of the island and the former U.S. Coast Guard Station may increase after completion of the environmental restoration project. Increased use will affect the historic property, but that effect will not be adverse. It is the Corps' determination that cultural resources included in or eligible for inclusion in the National Register of Historic Places are not likely to be located within the environmental restoration area. The Florida State Historic Preservation Office (SHPO) concurred with the Jacksonville District's determination that cultural resources will not be affected by the proposed project (Appendix A).

Maintenance

The area will be monitored by Palm Beach County (PBC) for plant survival rates and fisheries and wildlife utilization. Since Peanut Island is under lease to PBC, the project areas on the Island will be maintained, including exotic vegetation control, by PBC Parks and Recreation Department with the assistance of PBC Environmental Resources Management.

Hydraulic Information

The hydraulic characteristics of Lake Worth Lagoon have been greatly altered from historic conditions by changes in tidal influence and freshwater inflows. Peanut Island is located in the north-central Lake Worth Lagoon Estuary in designated Class III Waters. It is bordered to the east by the Lake Worth Inlet and to the west by the Intracoastal Waterway.

The tides are semidiurnal, having two high and two low water levels per day with little inequality. The tides have been monitored by the Florida Department of Environmental Protection (FDEP), Bureau of Survey and Mapping. Doug Thompson of FDEP recommends to extending published tidal datum (1-20-98):

Mean High Water	+1.51 feet NGVD
Mean Low Water	-1.09 feet NGVD
Mean Tidal Range	2.60 feet NGVD

The tide gauge for the project area is gauge No. 8722588, located at the Port of Palm Beach, Riviera Beach, Florida. Freshwater inflows to Lake Worth Lagoon according to South Florida Water Management District, 1977 are:

West Palm Beach Canal (C-51)	49.7%
Earman River (C-17)	12.1%
Boynton Canal (C-16)	10.7%
Surface Runoff	4.1%
Groundwater	22.3%

The C-51 canal is the largest inflow discharging an average of 356 million gallons per day. While 75% of the discharge flows north and reaches the Lake Worth Inlet within five days, 25% flows south and reaches South Lake Worth Inlet within nine days (SFWMD, 1977). The maximum residence time of the water body between the two inlets is approximately 14 days (Chiu et al., 1970). Miscellaneous hydrological and hydraulic facts for Lake Worth Lagoon are presented in Table 4 (Dames and Moore, 1990).

TABLE 4. HYDROLOGICAL FACTS

	HYDROLOGICAL FACTS
1.	Surface area of Lake Worth, including the bays is 2.64 X 10^8 $feet^2$.
2.	Surface area of Lake Worth between the two inlets is 1.96 X 10^8 $feet^2$.
3.	Volume of water below mean sea level, including the bays is 2.1 x 10^9 $feet^3$.
4.	Volume of water below mean sea level between the inlets is 1.73 x 10^9 $feet^3$.
5.	Average rainfall is 5.4 feet/year, a characteristic daily rainfall during the wet season is 1 inch/day.
6.	Typical evaporation rates are 0.05 inches/day during the winter, 0.22 inches/day during the summer (computed by Lee, 1975 for Card Sound, a lagoon on the Atlantic coast of Florida approximately 100 miles south of Lake Worth).
7.	An estimate of 281 cfs for the groundwater inflow was calculated for September 1974 and 1975 by J. van de Kreeke et al. 1976.
8.	The residence time of completely mixed pollutants - The time interval required to replace 50% of the resident water (half-life) is about two tidal cycles (or one day) and the pollutants are reduced to 10% of the original concentration in 6 to 8 tidal cycles (or 3 to 4 days).
9.	The residence time of stagnant pollutants - A particle was found to have a net drift of about 3000 feet per tidal cycle southward. A net inflow of about 2 X 10^4 feet per tidal cycle per foot width was found to be associated with this net drift. In this case, the maximum residence time of the water body between the two inlets would be about 14 days. (Chiu et al. 1970)
10.	Salinity variations in Lake Worth correspond closely to the seasonal variations in the fresh water inflow. The importance of groundwater inflow is illustrated by the salinity of 34 ppt during April, 1975 at Southern Boulevard Bridge compared to the ocean salinities of 36 ppt and higher when other freshwater sources were negligible. Salinity profiles along the length of Lake Worth (on 9/18/74) show a minimum of halfway between the two inlets. North of the West Palm Beach Canal, the salinity distribution oscillates over a distance approximately equal to the tidal excursion. Vertical salinity stratification is most pronounced south of the West Palm Beach Canal. (J. van de Kreek et al. 1976
11.	Friction factor (F) values in Lake Worth varied from 0.002 in the wider and deeper parts to 0.017 in the constrictions. The values of the friction factors are higher than the often recommend literature value F = 0.0025. A simplified one-dimensional analytical model yielded an overall friction factor of F = 0.017. The reason for these high values is the irregular bathymetry, in particular the constrictions, leading to a three-dimensional flow pattern (J. van de Kreeke et al. 1976).

Environmental Site Assessment

The Palm Beach County ERM has completed a *Phase I Environmental Site Assessment (ESA) of Peanut Island* in November, 1997. The island was examined for "Recognized Environmental Conditions" in accordance with American Society of Testing and Materials (ASTM) Standard 1527-94. The purpose of the investigation was to determine if there are any potential or existing environmental concerns associated with the subject site including; the presence of hazardous materials, the existence of soil or groundwater contamination, and the presence of environmental conditions or features. The assessment revealed no evidence of recognized environmental conditions (*Phase I Environmental Site Assessment*, Appendix E).

Tidal Hydrodynamic Modeling

Tomasello Consulting Engineers, Inc. was contracted by Palm Beach County ERM to conduct an extensive hydrodynamic model of the tidal dynamics in and around Peanut Island and the proposed tidal pond and shallow-water reef habitat in October 1996. The model was applied to simulate the behavior of the proposed improvements under typical tidal conditions. The impact of the tidal dynamics on the design alternatives is presented and implications to the final design are discussed in the narrative portion of *"Tidal Hydrodynamic Modeling of Peanut Island Improvements"*, Tomasello Consulting Engineers, 1997 (Appendix B) and the Coastal Systems Report.

Tomasello utilized the Environmental Fluid Dynamics Code (EFDC) model, which was applied to perform all simulations. The EFDC is a three dimensional hydrodynamic/transport model that can simulate the effects of tidal flows and other forcings on the distribution of dissolved and suspended materials in the water. The EFDC model was applied to the Peanut Island Model data set to simulate the tidal hydrodynamics in the Peanut Island vicinity and the exchange of resident Lake Worth Lagoon waters with incoming ocean waters. Various design scenarios of the proposed shallow-water reef and tidal pond were simulated to assist ERM in optimizing placement and design of proposed amenities

Jet Probe Investigation

Between March 6 and March10, 1998, Sea Systems Corporation conducted a jet probe investigation within two sites on Peanut Island to assess the subsurface sediment characteristics. The two locations are sites of future excavation operations to construct proposed modifications (Figure 13). The first area located on the southeast side of the island, has been designated to be a shallow water reef with design depths of -10' NGVD. The second area, on the west side of the island, is the proposed location of a tidal pond to be constructed to a design depth of -6' NGVD. Probes were completed within the limits of the proposed shallow water reef area and to the limits of the project design elevation (-10' NGVD). The observed subsurface conditions appeared to be free from any hardbottom or consolidated rock stratifications (Table 5).